

STRUCTURE AND COMPOSITION OF TWO BIRD COMMUNITIES IN THE SOUTHERN WESTERN GHATS¹

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(With 5 text-figures)

Key words: Bird community, tropical forest, Western Ghats, Kerala, India

The structure and composition of bird communities was studied in the Tropical Evergreen and Moist Deciduous forests of Silent Valley and Mukkali in the Western Ghats of south India from 1988 to 1993. Variable width line transects were employed to assess the bird community each month. To correlate the structure and composition of bird community to the vegetation type, parameters like girth class distribution of trees, maturity index of vegetation and vegetation profile diagrams were prepared. A total of 9,921 birds were recorded during the period of study, and altogether 137 taxa of birds were identified from the two vegetation types. Species richness of birds was similar in both the habitats. The yellow-browed bulbul (*Hypsipetes indicus*) was the most common and dominant species at Silent Valley (Tropical Evergreen), whereas at Mukkali (Tropical Moist Deciduous) black drongo (*Dicrurus adsimilis*) was the most common and jungle babbler (*Turdoides striatus*) was the dominant species. No significant difference in bird species richness between years was found in the Tropical Evergreen forests, whereas significant difference in species richness was obtained between different years in the Tropical Moist Deciduous Forest. The study showed that a high diversity index of vegetation (H') is an indication of increased density of birds in tropical forests.

INTRODUCTION

The structure and composition of bird communities are known to vary in different vegetation types (Wiens 1989). The pioneering studies of MacArthur and MacArthur (1961) established the relationship between bird diversity and vegetation structure. MacArthur *et al.* (1962), and MacArthur *et al.* (1966), supported the above hypothesis, but some studies showed negative relationship also (Wiens 1983). Studies on forest bird communities mainly examined parameters like the structure of forest bird communities (Nilson 1983), distributions (Howe *et al.* 1981) and community organization (Landers and MacMahon 1980). Yorke (1984) and Terborgh *et al.* (1990) described the community structure of tropical forest birds. Many workers have demonstrated the relationship between bird communities and forest

structure (Karr 1971, Karr and Roth 1971, Beedy 1981 and Rice *et al.* 1984). The roles of vegetation structure, competitors and productivity were described by Cody (1981) and the relation between total crown volume and bird diversity by Verner and Larson (1989). Similarly, patchiness of shrub distribution to diversity (Roth 1976), species richness to plant taxa (Terborgh 1985), tree species richness (James and Warner 1982) and birds in plantations and indigenous forest were described by Carlson (1986).

Even though many aspects of birds were studied in the Western Ghats of south India, (Vijayan and Balakrishnan 1977, Vijayan 1978, Zacharias and Gaston 1993, Srivastava *et al.* 1993, Nair *et al.* 1997) community studies of birds are few in number. Earlier workers (Anon. 1990) also carried out many faunal studies in the Evergreen Forests of Silent Valley. While studying the bird communities in the forests of northern Kerala, Ramakrishnan (1983) examined certain aspects of birds of Silent Valley. The relationship between birds and vegetation in New Delhi was revealed by Gaston (1979).

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Gandhi (1986) compared the bird community structure of scrub jungle and monoculture plantations. Diversity and community structure of birds were also studied by Daniels (1989), Daniels *et al.* (1990), Katti (1989) and Sundaramoorthy (1991).

The objective of the study was to evaluate and compare the structure and species composition of bird communities at two ecologically different habitats. Three characters of vegetation were analysed to compare and find out the relationships between the vegetation and bird community. The study forms part of a major investigation (Jayson 1994), which determined many ecological aspects of two bird communities. Seasonal changes in these bird communities were reported earlier (Jayson and Mathew 2000). Diversity and species abundance and distribution were also published (Jayson and Mathew 2000a).

STUDY AREA

The study area is located in Palakkad district, Kerala State, 45 km north of Mannarghat, the nearest town, in the Western Ghats of south India between 11° 3'-11° 13' N

and 76° 25'-76° 35' E. After evaluating the entire area, two study sites were selected: a Tropical Evergreen Forest, Silent Valley, and a Moist Deciduous Forest at Mukkali. The detailed description of the study areas with a map has been given earlier (Jayson and Mathew 2000). The first site is partially degraded and most of the disturbance happened in the late seventies and early eighties, in the course of felling trees and pre-construction work of an abandoned dam. The elevation of the tract varies from 500 m to 1,500 m above msl and the topography is undulating. These two study sites are separated by about 20 km, but the vegetation types differ. Anthropomorphic pressures were severe at Mukkali due to the proximity to human habitations. There was also a difference of 400 m in elevation between the two sites. There are two distinct seasons in the study area, monsoon season from end of May up to mid-November, and the dry summer season from December to April. There is no clearly marked winter. Fast southwesterly winds blow from the western side during the monsoon. Ombrothermic diagrams of Silent Valley and Mukkali are given in Figs 1 and 2.

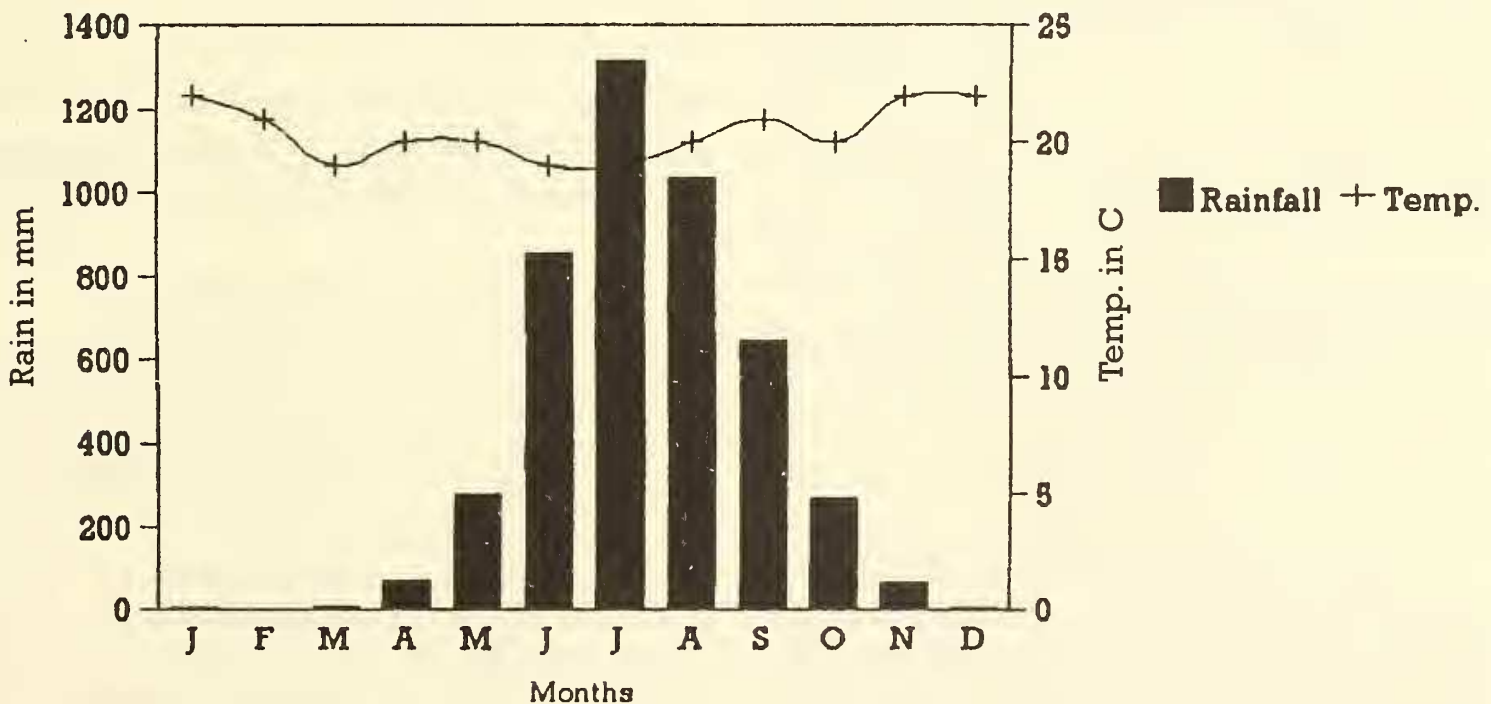


Fig. 1: Ombrothermic diagram of Silent Valley (1988-1993)

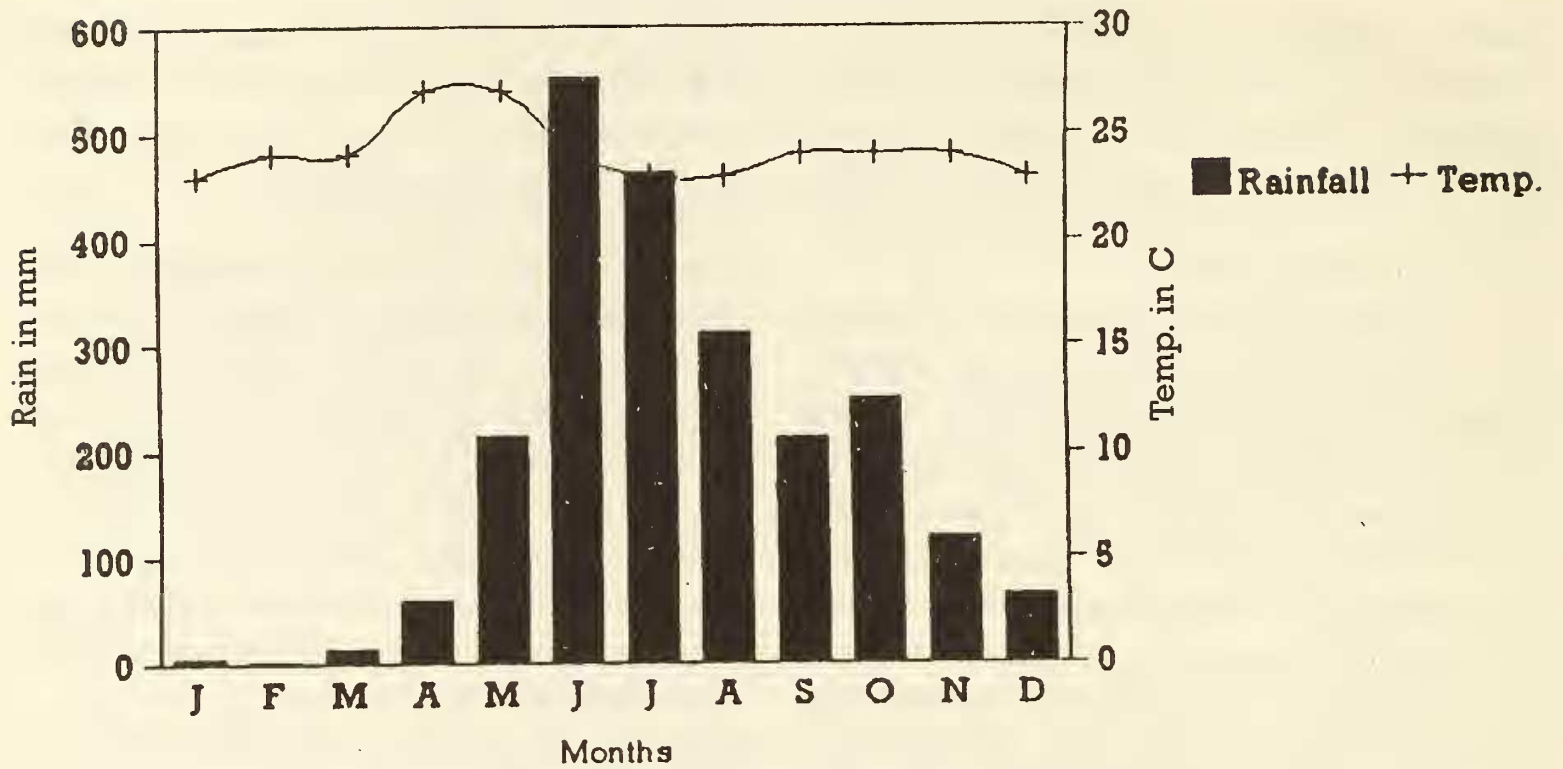


Fig. 2: Ombrothermic diagram of Mukkali (1988-1993)

METHODS

Vegetation: The vegetation structure, vegetation structure profile and the girth class distribution of trees in the study area were analysed. In addition to this, percentage composition of trees at the two areas was also measured.

Vegetation structure profile: A schematic diagram, which resembles the physiognomy of the stands of forest, is shown in the form of a profile diagram. It depicts a representative forest stand pictorially, size to scale. A 5 m x 50 m strip of forest stand was demarcated, and the position of each tree in it was marked on graph paper. Girth at breast height (GBH) and total height were recorded using a range finder. Crown shapes of individual trees were drawn on graph paper in the field. Using these pictorial and quantitative data, a profile diagram with measurements to scale (Richards 1952) was constructed.

Girth class distribution: Girth of trees at breast height (GBH) with more than 10 cm was measured randomly on both sides of the transect within a width of 30 m from the central line at Silent Valley and Mukkali. Altogether, 795 trees

were measured at Silent Valley and 552 trees were enumerated at Mukkali. From this data, girth class distribution was plotted.

Percentage composition of trees: One hundred plots of 5 m radius each in Silent Valley and 200 such plots in Mukkali were enumerated. Plots were enumerated on both sides of the transect line, the minimum distance between plots was 25 m. Among the 200 plots at Mukkali, 100 were in natural forest and the rest were in the coffee estate. All the trees above 10 cm in GBH were identified and recorded. The diversity and percentage composition of trees were worked out using the following formulae (Phillips 1959).

$$\text{Density (D)} = \frac{\text{Total number of individuals}}{\text{Total number of quadrats studied}}$$

$$\text{Abundance (Ab)} = \frac{\text{Total number of individuals}}{\text{Number of quadrats of occurrence}}$$

$$\% \text{ Frequency } = \frac{\text{Number of quadrats of occurrence}}{\text{Total number of quadrats studied}} \times 100$$

(% F)

$$\text{Relative density } = \frac{\text{Number of individuals of the species}}{\text{Number of individuals of all species}} \times 100$$

(RD)

$$\text{Relative frequency } = \frac{\text{Number of occurrence of the species in the quadrat}}{\text{Number of occurrence of all species}} \times 100$$

(RF)

The following formula is used to estimate maturity index value from the two study areas (Pichi-Sermolli 1948).

$$\text{Maturity index } = \frac{\text{Total \% frequency of a locality}}{\text{Total number of species present}}$$

(MI)

Diversity was calculated using Shannon-Wener Index ($H' = -\sum (p_i \ln p_i)$) with the program SPDIVERS.BAS developed by Ludwig and Reynolds (1988).

Birds: After considering all the available methods, the Variable Width Line Transect Method described by Burnham *et al.* (1980) was adopted, in which the observer walks through a fixed path, counting the birds seen or heard on both sides of the path. Whenever a bird was spotted, it was identified up to species and details like the number of birds, and habitat were noted. Birds were identified using a binocular (10 x 30) and with the help of field guides and reference books (Ali 1969, Ali and Ripley 1983).

Additionally, whenever a bird was sighted in the study period, it was identified and recorded.

Two line transects, each 4 km in length, were selected, one at Silent Valley and another at Mukkali. The transects covered representative habitats of the area, the first transect covered Evergreen Forest, burnt areas, and the second transect covered Moist Deciduous Forest, rocky patches, and burnt Moist Deciduous Forest. Observations were started 30 minutes after sunrise in all the months, and no census was done on days with very heavy rain and fog. Two observations were carried out in each area in a month. Altogether 150 samples of line transects were collected from the study area between May 1988 and April 1993. Among these, 80 line transects were from Silent Valley and 70 were from Mukkali spread over 45 months. There was a gap of 8 months from May 1991 to December 1991 in the collection of data.

To find out the common bird species of each area the Commonness Index of the two areas was computed. Commonness Index is the average frequency of sighting of a species in one sampling at a site. The relative dominance of each bird species in the two areas was determined by calculating the Dominance Index. The following formula was used for calculating Relative Dominance.

$$\text{Relative Dominance} = n_i \times 100/N$$

Where n_i = number of individuals of the species.

N = The total number of individuals of all the species seen during the study period.

RESULTS

Vegetation

Vegetation structure profile: Vegetation profile diagram of the Evergreen Forests showed trees in three canopy layers (Fig. 3). Trees having a height of more than 30 m were quite common; the trees were densely packed. One peculiarity

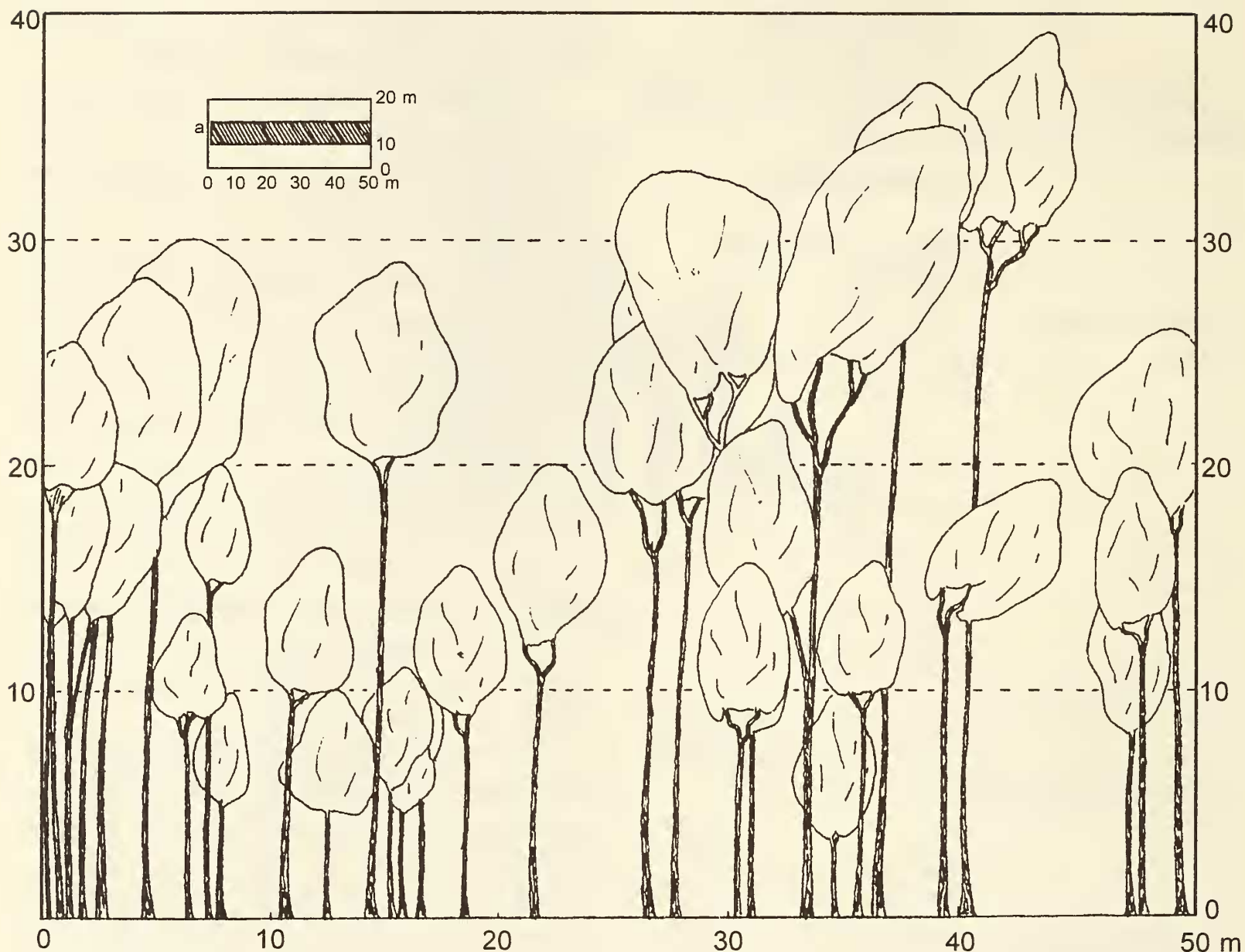


Fig. 3: Vegetation profile (5 m x 50 m) of Silent Valley showing different canopy levels

at Silent Valley was the presence of shola forests. The vegetation profile diagram of Mukkali showed only two distinct canopy levels (Fig. 4). Trees having a height of more than 30 m were very rare; the individual trees were very loosely packed.

Girth class distribution: Girth class distribution of trees (more than 10 cm GBH) recorded from Silent Valley and Mukkali is shown in Fig. 5. Being a wet Evergreen Forest, trees having more than 270 cm GBH were common at Silent Valley; but at Mukkali trees of large GBH were absent. Newly introduced trees in Mukkali were less than in Silent Valley (10-30 cm class). The prospect of new introductions

in Mukkali was also poor, mainly due to the illegal removal of poles for household purposes and firewood by locals. Most of the natural tree growth in the estate was maintained to provide shade to the coffee and pepper. The vegetation of this area was degraded and burnt clumps of bamboo were seen intermittently.

The following trees and shrubs were recorded from Mukkali: *Terminalia bellerica*, *Eucalyptus*, *Dalbergia lanceolaria*, *D. latifolia*, *Leucaena leucocephala*, *Erythrina suberosa*, *Grevillea robusta*, *Calotropis gigantea*, *Bambusa bambos*, *Ficus carica*, *Cassia fistula*, *Carica papaya*, *Grewia tiliaefolia*, *Bauhinia racemosa*, *Acacia concinna*, *Albizia lebbeck*, *Tamarindus*

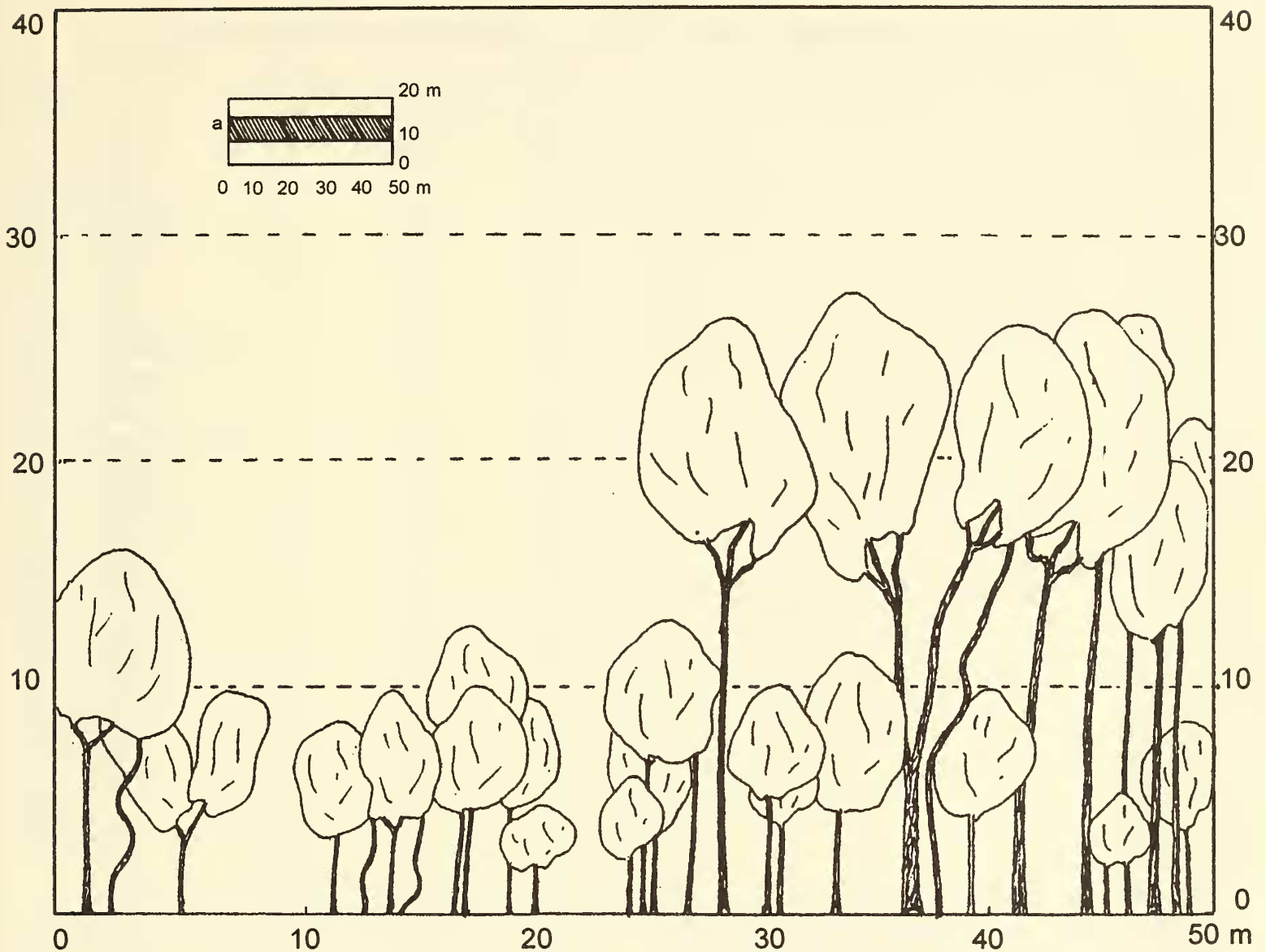


Fig. 4: Vegetation profile (5 m x 50 m) of Mukkali showing different canopy levels

indica, *Emblica officinalis*, *Pterocarpus marsupium*, *Solanum* sp., *Lantana camara*, *Antiaris toxicaria*, *Cycas* sp. and *Calophyllum inophyllum*. Other tree species included *Lagerstroemia flos-reginae*, *Litsea zeylanica*, *Cenchrus inhirini*, *Psychotria* sp., *Cipadessa baccifera*, *Xylia xylocarpa*, *Haldina cordifolia*, *Lagerstroemia microcarpa* and *Macaranga peltata*. Common shrubs recorded from the area were *Abutilon indica*, *Crotalaria* sp., *Pimpinella heyneana*, *Hibiscus* sp., *Impatiens flaccida* and *Heliotropium scabrum*. Grasses recorded were *Pennisetum*, *Thomeda* and *Cymbopogon*.

Percentage composition of trees: Silent Valley: Fifty-three species of trees were recorded from the plots at Silent Valley (Table 1). *Macaranga peltata* with 140 individuals had the

greatest abundance (2.85), highest density (0.70) and frequency (24.50) among the vegetation recorded (Table 1). Its relative density and frequency was also higher than the other vegetation. Maturity index of the vegetation at Silent Valley was 2.85 and Shannon-Wener diversity index was 2.91.

Mukkali: Twenty-two tree species numbering about 256 individuals were recorded from the plots (Table 2). *Albizia* had the greatest density and frequency, while *Terminalia chebula* was the most abundant among the other vegetation recorded.

Coffee Estate: *Terminalia paniculata* was the most dense and frequent, while *Erythrina suberosa* was the most abundant (Table 3). The maturity index of the natural forest was 10.00

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TABLE I
ABUNDANCE OF TREE SPECIES AT SILENT VALLEY (TROPICAL EVERGREEN FOREST)

Species	No. of individuals	D	Ab	% F	RD	RF
<i>Macaranga peltata</i>	140	0.70	2.85	24.50	30.43	16.0
Unidentified	2	0.01	2.00	0.50	0.43	0.32
<i>Persea macrantha</i>	7	0.03	1.16	3.00	1.52	1.96
<i>Cinnamomum zeylanicum</i>	1	0.01	1.00	0.50	0.21	0.32
<i>Schleichera oleosa</i>	6	0.03	1.00	3.00	1.30	1.96
<i>Diospyros</i> sp.	1	0.01	1.00	0.50	0.21	0.32
Unidentified	7	0.03	1.40	2.50	1.52	1.63
<i>Palaquium ellipticum</i>	28	0.14	1.40	10.00	6.08	6.55
<i>Cullenia</i> sp.	5	0.02	1.66	1.50	1.08	0.98
<i>Vateria indica</i>	4	0.02	1.33	1.50	0.87	0.98
<i>Melia dubia</i>	15	0.07	1.15	6.50	3.26	4.26
<i>Antidesma</i> sp.	8	0.04	1.00	4.00	1.73	2.62
<i>Syzygium cumini</i>	4	0.02	1.00	2.00	0.87	1.31
Unidentified	15	0.07	1.25	6.00	3.26	3.93
<i>Macaranga indica</i>	52	0.26	1.52	17.00	11.30	11.14
<i>Artocarpus integrifolia</i>	3	0.01	1.00	1.50	0.65	0.98
Unidentified	1	0.01	1.00	0.50	0.21	0.32
Unidentified	1	0.05	1.00	0.50	0.21	0.32
<i>Myristica attenuata</i>	12	0.06	1.50	4.00	2.60	2.62
<i>Trema orientalis</i>	1	0.01	1.00	0.50	0.21	0.32
<i>Lansium</i> sp.	16	0.08	1.45	5.50	3.47	3.60
<i>Bischofia javanica</i>	20	0.10	1.05	9.50	4.34	6.22
Unidentified	4	0.02	1.00	2.00	0.87	1.31
Unidentified	1	0.01	1.00	0.50	0.21	1.31
Unidentified	1	0.01	1.00	0.50	0.21	0.32
<i>Alstonia scholaris</i>	1	0.01	1.00	0.50	0.21	0.32
<i>Xanthophyllum flavescens</i>	1	0.01	1.00	0.01	0.21	0.32
<i>Symplocos</i> sp.	1	0.01	1.00	0.50	0.21	0.32
<i>Mangifera indica</i>	1	0.01	1.00	0.50	0.21	0.32
<i>Sterculia foetida</i>	1	0.01	1.00	0.50	0.21	0.32
<i>Trema orientalis</i>	2	0.01	1.00	0.50	0.43	0.65
Black berry	3	0.01	1.50	1.00	0.43	0.65
Unidentified	2	0.01	1.00	1.00	0.43	0.65
Unidentified	1	0.01	1.00	0.50	0.21	0.32
<i>Elaeocarpus tuberculatus</i>	11	0.05	2.20	2.50	2.39	1.63
<i>Dysoxylum malabaricum</i>	16	0.08	1.00	8.00	3.47	5.24
<i>Albizzia lebeck</i>	3	0.01	1.00	1.50	0.65	0.98
Unidentified	3	0.01	1.00	1.50	0.65	0.98
Unidentified	1	0.01	1.00	0.50	0.21	0.32
<i>Calophyllum inophyllum</i>	5	0.02	1.66	1.50	1.08	0.98
<i>Holigarna fragrans</i>	6	0.03	1.50	2.00	1.30	1.31
<i>Polyalthia fragrans</i>	11	0.05	1.57	3.50	2.39	2.29
<i>Mesua ferrea</i>	16	0.08	1.23	6.50	3.47	4.26
Unidentified	2	0.01	1.00	1.00	0.43	0.65
<i>Nothapodytes foetida</i>	3	0.01	1.00	1.50	0.65	0.98
Unidentified	1	0.01	1.00	0.50	0.21	0.32
<i>Terminalia</i> sp.	1	0.01	1.00	0.50	0.21	0.32
<i>Phoebe malabarica</i>	5	0.02	1.00	2.50	1.08	1.63
<i>Ficus</i> sp.	2	0.01	1.00	1.00	0.43	0.65
Unidentified	3	0.01	1.00	1.50	0.65	0.98
Unidentified	1	0.01	1.00	0.50	0.21	0.32
<i>Garcinia gummi-gutta</i>	1	0.01	1.00	0.50	0.21	0.32
Unidentified	1	0.01	1.00	0.50	0.21	0.32

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TABLE 2
ABUNDANCE OF TREE SPECIES AT MUKKALI (TROPICAL MOIST DECIDUOUS FOREST)

Species	No. of individuals	D	Ab	% F	RD	RF
<i>Grewia tiliaefolia</i>	32	0.32	1.10	29	12.50	13.18
<i>Albizia lebbbeck</i>	49	0.49	1.08	45	19.14	20.45
<i>Dalbergia latifolia</i>	27	0.27	1.12	24	10.54	10.90
<i>Bambusa bambos</i>	11	0.11	1.00	11	4.29	5.00
<i>Bombax ceiba</i>	5	0.05	1.00	5	1.95	2.27
<i>Sapindus laurifolius</i>	1	0.01	1.00	1	0.39	0.45
<i>Terminalia paniculata</i>	39	0.39	1.30	30	15.23	13.63
<i>Emblica officinalis</i>	7	0.07	1.00	7	2.73	3.18
<i>Xylia xylocarpa</i>	5	0.05	1.00	5	1.95	2.27
<i>Pterocarpus marsupium</i>	2	0.02	1.00	2	0.78	0.90
<i>Ficus racemosa</i>	7	0.07	1.00	7	2.73	3.18
<i>Terminalia bellerica</i>	1	0.01	1.00	1	0.39	0.45
<i>Lagerstroemia microcarpa</i>	6	0.06	1.20	5	2.34	2.27
<i>Cassia fistula</i>	2	0.02	1.00	2	0.78	0.90
<i>Tetrameles nudiflora</i>	1	0.01	1.00	2	0.39	0.45
<i>Terminalia chebula</i>	16	0.16	1.45	11	6.25	5.00
<i>Haldina cordifolia</i>	1	0.01	1.00	1	0.39	0.45
<i>Scleichera oleosa</i>	3	0.03	1.00	3	1.17	1.36
<i>Spondias</i> sp.	2	0.02	1.00	2	0.78	0.90
<i>Erythrina stricta</i>	6	0.06	1.20	5	2.34	2.27
<i>Macaranga</i> sp.	1	0.01	1.00	1	0.39	0.45
Others	32	0.37	1.45	22	12.50	10.00

TABLE 3
ABUNDANCE OF TREE SPECIES AT MUKKALI (COFFEE ESTATE)

Species	No. of individuals	D	Ab	% F	RD	RF
<i>Terminalia paniculata</i>	49	0.49	1.25	39	15.75	15.61
<i>Grevillea robusta</i>	47	0.47	1.38	34	15.11	14.34
<i>Dalbergia latifolia</i>	31	0.31	1.29	24	9.96	10.12
<i>Kydia calycina</i>	1	0.01	1.00	1	0.32	0.42
<i>Pterocarpus marsupium</i>	2	0.02	1.00	2	0.64	0.84
<i>Xylia xylocarpa</i>	16	0.16	1.45	11	5.14	4.66
<i>Terminalia bellerica</i>	10	0.10	1.11	9	2.21	3.79
<i>Cassia fistula</i>	6	0.06	1.20	5	1.92	2.10
<i>Albizia lebbbeck</i>	25	0.25	1.31	19	8.03	8.01
<i>Grewia tiliaefolia</i>	24	0.24	1.33	18	7.71	7.59
<i>Lagerstroemia</i> sp.	15	0.15	1.00	15	4.82	6.32
<i>Eucalyptus</i> sp.	1	0.01	1.00	1	0.32	0.42
<i>Erythrina stricta</i>	37	0.37	1.85	20	11.89	8.43
<i>Carica papaya</i>	2	0.02	1.00	2	0.64	0.84
<i>Ficus racemosa</i>	4	0.04	1.00	4	1.28	1.68
<i>Terminalia chebula</i>	10	0.10	1.11	9	3.21	3.79
<i>Bambusa bambos</i>	2	0.02	1.00	2	0.64	0.84
<i>Schleichera oleosa</i>	1	0.01	1.00	2	0.32	0.42
<i>Bauhinia</i> sp.	1	0.01	1.00	1	0.32	0.42
<i>Emblica officinalis</i>	1	0.01	1.00	1	0.32	0.42

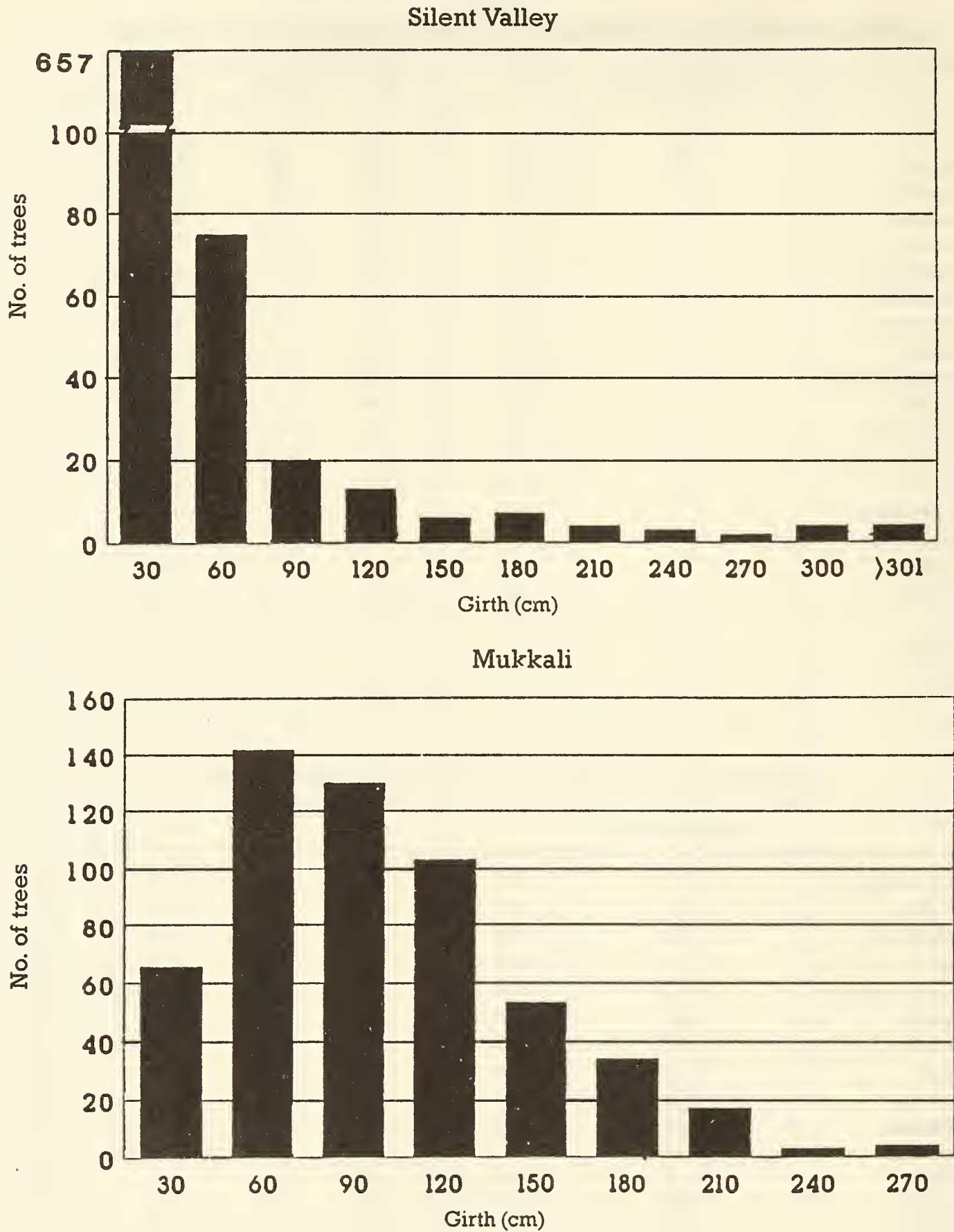


Fig. 5: Girth class distribution of trees at Silent Valley and Mukkali

and that of the estate was 11.28. Shannon-Wener diversity index of trees at Mukkali was 2.57.

Occurrence of bird species: *Silent Valley*: Ninety-nine taxa from 10 Orders and 31 Families

were recorded from Silent Valley. Occurrence of birds in different months over the study period is given in Table 4. Six species were recorded in all the months, namely blossom-headed parakeet

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TABLE 4
OCCURRENCE OF BIRDS AT SILENT VALLEY IN DIFFERENT MONTHS (1988-1993)

Sl. No.	Species	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
42	<i>Ardeola grayii</i> *	P	-	P	-	P	P	-	-	-	-	-	-
124	<i>Elanus caeruleus</i>	P	P	P	-	-	-	-	P	-	-	-	-
135	<i>Haliastur indus</i> *	-	-	P	-	-	-	-	-	-	P	-	-
139	<i>Accipiter badius</i> *	-	-	P	-	-	-	P	-	-	-	P	-
172	<i>Ictinaetus malayensis</i>	P	-	-	P	P	P	-	-	P	-	P	P
196	<i>Spilornis cheela</i>	-	-	P	-	P	-	-	P	-	P	P	-
211	<i>Falco</i> sp.	-	-	-	-	-	-	-	-	-	-	P	P
263	<i>Perdicula erythrorhyncha</i> *	P	P	P	P	P	P	P	P	-	-	-	P
275	<i>Galloperdix spadicea</i> *	-	-	P	-	-	-	-	P	-	-	P	-
301	<i>Gallus sonneratii</i>	P	P	P	P	P	P	P	-	P	P	P	P
496	<i>Treron pompadora</i>	P	-	P	P	P	-	-	-	-	-	-	-
503	<i>Treron phoenicoptera</i> *	P	-	P	-	P	-	-	-	-	-	P	P
506	<i>Ducula aenea</i>	P	-	-	-	-	-	-	-	-	-	-	-
510	<i>Ducula badia</i> *	P	P	P	P	-	-	-	P	-	-	-	-
516	<i>Columba livia</i> *	-	-	P	-	-	-	-	-	-	-	-	-
521	<i>Columba elphinstonii</i> *	-	P	-	-	-	-	-	-	-	-	-	-
537	<i>Streptopelia chinensis</i>	-	-	-	-	-	-	-	-	-	-	-	P
542	<i>Chalcophaps indica</i> *	P	-	P	P	-	-	-	-	-	-	P	P
550	<i>Psittacula krameri</i>	P	-	P	-	P	P	-	P	P	P	P	P
558	<i>Psittacula cyanocephala</i>	P	P	P	P	P	P	P	P	P	P	P	P
564	<i>Psittacula columboides</i>	P	-	P	P	-	-	P	P	-	-	P	P
566	<i>Loriculus vernalis</i>	P	-	P	-	-	-	-	P	-	P	P	P
569	<i>Clamator coromandus</i>	-	-	-	-	-	-	-	P	-	-	-	-
600	<i>Centropus sinensis</i>	-	-	P	-	-	-	-	-	-	-	-	-
664	<i>Asio flammeus</i>	-	-	P	-	-	-	-	-	-	-	-	-
692	<i>Zoonavena sylvatica</i>	-	P	-	-	-	-	-	P	-	-	-	P
712	<i>Harpactes fasciatus</i>	-	-	P	-	-	-	-	-	-	-	-	-
744	<i>Merops leschenaulti</i>	P	-	-	P	-	-	-	P	-	-	-	P
768	<i>Ocyrceros griseus</i>	P	P	P	-	-	P	P	-	P	-	-	P
776	<i>Buceros bicornis</i>	-	P	-	-	-	P	-	-	-	-	-	-
785	<i>Megalaima viridis</i>	P	P	P	P	P	P	-	P	P	P	P	P
798	<i>Picumnus innominatus</i>	-	-	-	-	-	-	-	P	P	-	-	-
821	<i>Dinopium benghalense</i>	P	P	P	P	P	P	P	P	P	P	P	P
825	<i>Dinopium javanense</i>	P	P	-	P	-	-	-	-	-	-	-	-
830	<i>Dryocopus javensis</i> *	P	-	-	P	P	-	-	-	-	-	-	-
856	<i>Hemicircus canente</i>	-	-	-	P	P	P	-	-	-	-	-	-
867	<i>Pitta brachyura</i>	P	P	-	-	-	-	-	-	-	-	-	P
919	<i>Hirundo tahitica</i>	P	-	P	P	-	-	-	-	-	-	P	P
923	<i>Hirundo daurica</i>	P	P	P	P	P	P	-	P	P	P	P	P
949	<i>Lanius cristatus</i>	P	-	-	-	-	-	-	-	-	-	-	-
952	<i>Oriolus oriolus</i>	P	-	-	-	-	-	-	-	-	-	-	-
954	<i>Oriolus chinensis</i> *	P	-	-	-	-	-	-	-	-	-	-	P
958	<i>Oriolus xanthornus</i>	P	-	P	-	-	-	-	-	-	-	-	-
963	<i>Dicrurus macrocercus</i>	P	P	P	P	P	-	-	P	-	P	P	P
967	<i>Dicrurus caeruleus</i> *	-	-	-	-	-	-	-	-	-	-	P	P
971	<i>Dicrurus aeneus</i>	-	P	-	-	-	-	-	-	-	P	P	-
977	<i>Dicrurus paradiseus</i>	P	P	P	P	P	P	P	P	P	-	P	P
1006	<i>Acridotheres tristis</i>	-	-	-	-	P	-	-	-	-	-	-	-
1015	<i>Gracula religiosa</i>	P	P	P	P	P	P	-	-	P	-	P	P
1032	<i>Dendrocitta vagabunda</i>	-	-	-	-	-	-	-	-	P	-	-	-

STRUCTURE AND COMPOSITION OF BIRD COMMUNITIES

TABLE 4 (CONTD.)
OCCURRENCE OF BIRDS AT SILENT VALLEY IN DIFFERENT MONTHS (1988-1993)

Sl. No. Species	Months											
	J	F	M	A	M	J	J	A	S	O	N	D
1034 <i>Dendrocitta leucogastra</i>	P	P	P	P	P	P	P	P	P	P	P	P
1054 <i>Corvus macrorhynchos</i>	-	-	P	-	-	-	-	-	-	-	-	-
1081 <i>Pericrocotus flammeus</i>	P	-	P	P	P	P	P	P	P	P	P	P
1098 <i>Aegithina tiphia</i>	-	-	-	P	-	-	-	-	-	-	-	-
1103 <i>Chloropsis aurifrons</i>	P	-	-	P	-	-	-	-	-	-	-	-
1109 <i>Irena puella</i>	-	-	-	P	-	-	-	-	-	-	-	-
1116 <i>Pycnonotus melanicterus</i>	-	-	-	-	-	-	-	-	-	-	P	-
1120 <i>Pycnonotus jocosus</i>	P	P	P	P	P	P	P	P	P	P	-	P
1128 <i>Pycnonotus cafer</i>	-	-	P	-	-	-	P	P	-	-	P	P
1144 <i>Iole indicus</i>	P	P	P	P	P	P	P	P	P	P	P	P
1148 <i>Hypsipetes leucocephalus</i>	P	P	P	P	-	-	-	-	P	-	P	P
1154 <i>Pellorneum ruficeps</i>	-	-	P	-	-	-	P	-	-	-	-	-
1174 <i>Pomatorhinus schisticeps</i>	P	-	-	P	P	-	-	-	-	-	-	-
1224 <i>Rhopocichla atriceps*</i>	-	-	-	-	-	-	-	P	P	-	-	-
1259 <i>Turdoides subrufus</i>	-	-	-	-	-	-	-	-	-	-	-	P
1265 <i>Turdoides striatus</i>	P	P	P	P	P	P	P	P	P	P	P	P
1267 <i>Turdoides affinis</i>	-	P	-	-	-	-	-	-	-	-	-	-
1407 <i>Muscicapa daurica*</i>	-	-	P	-	-	-	-	-	-	-	-	-
1408 <i>Muscicapa muttui</i>	-	-	-	-	-	-	P	-	-	-	-	-
1435 <i>Cyornis pallipes*</i>	-	-	-	-	-	-	-	-	-	-	P	-
1442 <i>Cyornis tickelliae</i>	P	P	P	-	P	-	-	-	-	-	-	P
1446 <i>Eumyias albicaudata*</i>	-	-	-	-	-	-	-	-	-	-	-	P
1461 <i>Terpsiphone paradisi</i>	P	-	-	-	-	-	-	-	-	-	P	-
1601 <i>Phylloscopus sp.</i>	P	P	-	-	P	P	-	-	P	-	P	P
1661 <i>Copsychus saularis</i>	-	-	-	-	P	-	-	-	-	-	-	-
1700 <i>Saxicola caprata</i>	P	P	P	P	P	P	P	P	P	-	P	P
1728 <i>Myiophonus horsfieldii</i>	P	P	P	P	P	P	P	P	P	P	-	P
1733 <i>Zoothera citrina</i>	P	P	-	-	-	-	-	-	-	-	P	P
1752 <i>Turdus merula</i>	P	-	-	P	-	P	-	-	-	-	P	P
1794 <i>Parus major</i>	-	-	-	-	P	-	-	-	-	-	-	-
1809 <i>Parus xanthogenys</i>	-	-	P	P	P	P	P	-	-	-	P	-
1838 <i>Sitta frontalis</i>	-	-	-	P	P	P	-	-	-	-	-	-
1852 <i>Anthus novaeseelandiae*</i>	P	-	-	-	-	-	-	-	-	-	-	-
1874 <i>Dendronanthus indica</i>	-	-	-	P	-	-	-	-	-	-	-	-
1876 <i>Motacilla flava</i>	P	P	P	-	-	-	-	-	P	P	P	P
1884 <i>Motacilla cinerea*</i>	-	-	-	-	-	-	-	-	-	-	P	-
1892 <i>Dicaeum agile*</i>	-	-	-	-	-	-	-	-	-	P	-	-
1899 <i>Dicaeum erythrorhynchos*</i>	P	-	P	-	P	P	-	P	P	-	P	-
1908 <i>Nectarinia zeylonica</i>	-	-	-	-	-	-	-	-	P	-	-	-
1909 <i>Nectarinia minima</i>	P	P	P	P	-	P	P	P	P	P	P	P
1912 <i>Nectarinia lotenia</i>	-	-	-	-	-	-	-	-	P	P	-	-
1931 <i>Arachnothera longirostra</i>	-	P	P	P	P	-	-	-	-	-	-	-
1933 <i>Zosterops palpebrosus</i>	-	-	-	P	P	P	-	P	P	-	P	-
1966 <i>Lonchura malabarica</i>	P	-	-	-	-	-	-	-	-	-	-	-
1973 <i>Lonchura kelaarti</i>	-	-	-	-	-	-	-	-	P	-	-	-
1974 <i>Lonchura punctulata*</i>	-	-	-	-	-	-	-	-	-	-	-	P
1978 <i>Lonchura malacca</i>	P	-	-	-	-	-	-	P	-	-	-	P
2013 <i>Carpodacus erythrinus</i>	P	P	P	-	-	-	-	-	-	-	-	P

* = Recorded only from Silent Valley, P = Present; (-) Not recorded
Serial numbers correspond to the Handbook of Ali and Ripley (1983).

(*Psittacula roseata*), lesser golden-backed woodpecker (*Dinopium benghalense*), white-bellied treepie (*Dendrocitta leucogastra*), yellow-browed bulbul (*Iole indica*) and Malabar whistling-thrush (*Myiophonus horsfieldii*). The most common species found at Silent Valley was the yellow-browed bulbul followed by the white-cheeked barbet (*Megalaima viridis*), pied bushchat (*Saxicola caprata*) and common hill-myna (*Gracula religiosa*). The Commonness and Dominance Index of 10 selected species at Silent Valley is given in Table 5. The dominant species in the community at Silent Valley were yellow-browed bulbul, black-crested bulbul (*Pycnonotus melanicterus*), common hill-myna, jungle babbler (*Turdoides striatus*) and pied bushchat. Thirty species recorded only from the Silent Valley are indicated with an asterisk in Table 4. Eight endemic species restricted to the Western Ghats: Nilgiri wood-pigeon (*Columba elphinstonii*), bluewinged parakeet (*Psittacula columboides*), Malabar grey hornbill (*Ocyrceros griseus*), Indian scimitar-babbler (*Pomatorhinus schisticeps*), Nilgiri flycatcher (*Eumyias albicaudata*), whitebellied blue flycatcher (*Cyornis pallipes*), small sunbird (*Nectarinia minima*) and white-bellied treepie were recorded from the area. Among these, the Nilgiri wood pigeon is a globally threatened species. Number of individuals of each species recorded from the

transect is given in Appendix 1.

Mukkali: Ninety-six taxa from 10 Orders and 30 Families were recorded from Mukkali. Monthly distribution of various species is given in Table 6. Seven species, namely spotted dove (*Streptopelia chinensis*), white-cheeked barbet (*Megalaima viridis*) lesser golden-backed woodpecker, greater racket-tailed drongo (*Dicrurus paradiseus*), red-whiskered bulbul, redvented bulbul (*Pycnonotus jocosus*) and jungle babbler were recorded in all the months. The most common species were the black drongo (*Dicrurus macrocercus*), white-cheeked barbet, jungle babbler, redvented bulbul and greater racket-tailed drongo. Jungle babbler, red-whiskered bulbul and black drongo were the most dominant species. The Dominance and Commonness Index of 10 selected species is given in Table 7. Twenty-one species recorded only from Mukkali are marked with an asterisk in Table 6. Altogether 137 taxa of birds were recorded from both the vegetation types in this study. Number of individuals, from the transect, in each species is given in Appendix I.

Changes in bird species richness: Distinct changes in the species composition was recorded among the birds of the Silent Valley and Mukkali over different months. During the monsoon months, the number of species present in Silent Valley was low. But as the rain stopped, new species arrived and a maximum of fifty-five species were recorded in January (Table 8). Reduction in species richness during the monsoon season was observed throughout the study period. Similarly, a surge in species richness was recorded during summer, in all the years. A similar trend was observed in Mukkali. No significant difference in bird species richness, between years in monsoon ($X^2 = 4.28$; $P < 0.05$) and summer ($X^2 = 8.92$; $P < 0.05$) was seen at Silent Valley. But at Mukkali, a significant difference was observed between years in monsoon ($X^2 = 38.97^*$; $P < 0.001$) and summer ($X^2 = 14.64$; $P < 0.001$) seasons.

TABLE 5
COMMONNESS AND DOMINANCE INDEX
OF SELECTED SPECIES AT SILENT VALLEY
(TROPICAL EVERGREEN FOREST)

No.	Species	Commonness Index	Dominance Index
1.	<i>Hypsipetes indicus</i>	6.29	20.33
2.	<i>Hypsipetes leucocephalus</i>	1.32	9.27
3.	<i>Gracula religiosa</i>	1.44	8.04
4.	<i>Saxicola caprata</i>	1.44	4.29
5.	<i>Megalaima viridis</i>	1.78	4.19
6.	<i>Pycnonotus jocosus</i>	1.18	3.38
7.	<i>Myiophonus horsfieldii</i>	0.98	1.92
8.	<i>Gallus sonneratii</i>	0.96	2.00
9.	<i>Dendrocitta leucogastra</i>	0.83	1.63
10.	<i>Dinopium benghalense</i>	0.81	1.52

STRUCTURE AND COMPOSITION OF BIRD COMMUNITIES

TABLE 6
OCCURRENCE OF BIRDS AT MUKKALI IN DIFFERENT MONTHS (1988-1993)

S.No.	Species	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
124	<i>Elanus caeruleus</i>	P	-	-	P	-	P	P	-	P	P	P	P
139	<i>Accipiter badius</i>	-	-	-	P	-	-	-	-	-	-	-	-
172	<i>Ictinaetus malayensis</i>	-	-	P	-	-	-	-	-	-	P	-	-
196	<i>Spilornis cheela</i>	-	-	-	-	-	P	-	-	-	-	-	P
211	<i>Falco sp.</i>	-	-	-	-	-	-	-	-	P	-	-	-
301	<i>Gallus sonneratii</i>	P	P	P	P	P	-	-	-	P	P	P	P
496	<i>Treron pompadora</i>	-	-	-	-	P	-	-	-	-	-	-	-
537	<i>Streptopelia chinensis</i>	P	P	P	P	P	P	P	P	P	P	P	P
550	<i>Psittacula krameri</i>	P	P	P	P	P	P	P	-	P	P	P	P
558	<i>Psittacula cyanocephala</i>	P	P	P	P	-	-	-	-	P	P	P	P
564	<i>Psittacula columboides</i>	-	P	P	P	-	-	-	-	-	-	-	-
566	<i>Loriculus vernalis</i>	-	P	P	P	P	P	-	-	-	-	-	-
573	<i>Hierococyx varius*</i>	-	-	-	-	P	-	-	-	-	-	-	-
590	<i>Eudynamys scolopacea*</i>	-	-	P	-	-	-	-	-	-	-	-	-
600	<i>Centropus sinensis</i>	-	-	-	-	P	-	-	-	-	-	-	P
636	<i>Glaucidium radiatum</i>	-	-	P	P	-	-	-	-	-	-	-	P
664	<i>Asio flammeus</i>	-	P	-	-	-	-	-	-	-	-	-	-
712	<i>Harpactes fasciatus</i>	-	-	P	-	-	-	-	-	P	-	P	-
736	<i>Halcyon smyrnensis*</i>	-	-	P	P	-	P	P	-	-	-	P	P
744	<i>Merops leschenaulti</i>	-	-	-	P	P	-	-	-	-	-	P	P
763	<i>Upupa epops*</i>	-	-	P	-	-	P	-	-	-	-	-	P
768	<i>Ocyrceros griseus</i>	-	-	-	P	-	P	P	-	-	-	-	P
776	<i>Buceros bicornis</i>	-	-	-	-	-	P	-	-	-	-	-	-
785	<i>Megalaima viridis</i>	P	P	P	P	P	P	P	P	P	P	P	P
815	<i>Picus chlorolophus*</i>	-	-	-	-	-	P	-	-	-	-	-	-
825	<i>Dinopium javanense</i>	-	-	P	-	-	-	-	P	P	-	-	P
826	<i>Dinopium benghalense</i>	P	P	P	P	P	P	P	P	P	P	P	P
856	<i>Hemicircus canente</i>	-	-	P	P	-	-	-	P	-	-	P	P
867	<i>Pitta brachyura</i>	-	P	P	-	-	-	-	-	-	-	-	-
919	<i>Hirundo tahitica</i>	P	P	P	-	P	-	-	P	-	-	P	P
923	<i>Hirundo daurica</i>	-	-	-	-	-	P	-	-	-	-	-	-
933	<i>Lanius excubitor*</i>	-	-	P	-	-	-	-	-	-	-	-	-
940	<i>Lanius vittatus*</i>	-	-	P	-	P	P	-	-	-	-	-	-
946	<i>Lanius schach *</i>	P	P	-	-	-	-	-	-	-	-	-	-
952	<i>Oriolus oriolus</i>	-	P	-	-	-	-	-	-	-	-	-	-
958	<i>Oriolus xanthornus</i>	-	P	P	P	P	P	-	-	P	-	P	-
963	<i>Dicrurus macrocercus</i>	P	P	P	P	P	P	P	-	P	P	P	P
971	<i>Dicrurus aeneus</i>	P	P	-	P	-	P	P	P	P	P	P	-
973	<i>Dicrurus hottentottus*</i>	-	-	-	-	P	-	-	-	-	-	-	-
977	<i>Dicrurus paradiseus</i>	P	P	P	P	P	P	P	P	P	P	P	P
1006	<i>Acridotheres tristis</i>	P	P	P	P	P	-	-	-	-	-	-	-
1009	<i>Acridotheres fuscus</i>	-	P	P	-	P	-	-	-	-	-	-	-
1015	<i>Gracula religiosa</i>	P	P	-	-	P	P	-	-	-	-	-	-
1032	<i>Dendrocitta vagabunda</i>	P	-	P	P	P	-	P	P	P	P	P	-
1034	<i>Dendrocitta leucogastra</i>	P	-	P	-	P	P	P	-	P	-	P	-
1049	<i>Corvus splendens *</i>	-	P	-	-	P	-	P	-	P	-	P	-
1054	<i>Corvus macrorhynchos</i>	P	-	P	-	-	-	-	-	-	-	-	-
1077	<i>Coracina melanoptera*</i>	-	-	P	-	-	-	-	-	P	-	-	-
1081	<i>Pericrocotus flammeus</i>	P	-	P	P	-	P	P	-	P	P	P	P

STRUCTURE AND COMPOSITION OF BIRD COMMUNITIES

TABLE 6 (CONTD.)
OCCURRENCE OF BIRDS AT MUKKALI IN DIFFERENT MONTHS (1988-1993)

S. No.	Species	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
1098	<i>Aegithina tiphia</i>	P	P	P	-	-	P	-	-	-	-	-	-
1103	<i>Chloropsis aurifrons</i>	P	-	P	P	-	P	P	-	P	-	P	P
1108	<i>Chloropsis cochinchinensis*</i>	-	P	-	-	P	-	-	-	-	P	-	-
1109	<i>Irena puella</i>	-	-	-	P	-	P	-	-	-	-	-	-
1116	<i>Pycnonotus melanicterus gularis</i>	-	-	P	P	-	-	-	P	-	-	-	-
1120	<i>Pycnonotus jocosus</i>	P	P	P	P	P	P	P	P	P	P	P	P
1128	<i>Pycnonotus cafer</i>	P	P	P	P	P	P	P	P	P	P	P	P
1144	<i>Hypsipetes indicus</i>	P	P	P	P	-	P	P	P	P	P	P	P
1148	<i>Hypsipetes leucocephalus</i>	P	-	P	-	-	P	-	-	P	P	P	P
1174	<i>Pomatorhinus schisticeps</i>	-	-	-	-	-	-	-	-	P	-	-	-
1259	<i>Turdoides subrufus</i>	-	P	-	-	-	-	-	-	-	P	-	-
1265	<i>Turdoides striatus</i>	P	P	P	P	P	P	P	P	P	P	P	P
1267	<i>Turdoides affinis</i>	P	-	P	P	P	P	-	-	-	P	P	-
1407	<i>Muscicapa latirostris</i>	-	P	-	-	-	-	-	-	P	-	P	-
1408	<i>Muscicapa muttui</i>	P	-	-	-	-	-	-	-	-	-	-	-
1409	<i>Muscicapa ruficauda*</i>	P	-	-	-	-	-	-	-	-	-	-	-
1427	<i>Ficedula nigrorufa *</i>	P	-	-	-	-	-	-	-	-	-	-	-
1445	<i>Eumyias thalassina*</i>	P	-	-	-	-	-	-	-	-	-	-	-
1461	<i>Terpsiphone paradisi</i>	-	-	P	-	-	-	-	-	-	-	-	P
1538	<i>Orthotomus sutorius</i>	-	-	-	P	P	-	-	-	-	P	P	-
1601	<i>Phylloscopus sp.</i>	P	P	-	-	P	-	-	-	-	P	P	-
1661	<i>Copsychus saularis</i>	P	P	P	P	P	P	-	P	-	P	P	P
1700	<i>Saxicola caprata</i>	P	P	P	-	-	P	-	P	P	P	P	P
1726	<i>Monticola solitarius</i>	P	P	-	-	-	-	-	P	-	-	-	-
1728	<i>Myiophonus horsfieldii</i>	-	-	P	P	-	P	P	P	-	-	P	-
1733	<i>Zoothera citrina</i>	P	-	-	-	-	-	-	-	-	-	-	-
1794	<i>Parus major</i>	P	P	-	-	-	-	-	-	-	-	-	-
1809	<i>Parus xanthogenys</i>	-	P	P	-	-	-	P	-	-	-	-	-
1838	<i>Sitta frontalis</i>	-	-	-	-	P	P	-	-	-	P	-	-
1874	<i>Dendronanthus indica</i>	P	-	P	-	-	-	-	-	-	-	-	-
1876	<i>Motacilla flava</i>	P	P	P	-	-	-	-	-	P	P	P	P
1885	<i>Motacilla alba*</i>	-	-	-	-	-	-	-	-	-	P	-	-
1899	<i>Dicaeum erythrorhynchos</i>	P	P	-	-	-	-	-	-	-	-	-	P
1908	<i>Nectarinia zeylonica</i>	-	P	-	-	P	-	-	-	P	P	P	P
1909	<i>Nectarinia minima</i>	P	-	P	-	-	-	-	-	-	-	P	-
1912	<i>Nectarinia lotenia</i>	-	P	-	P	-	-	-	-	P	-	-	-
1931	<i>Arachnothera longirostra</i>	-	-	-	-	-	-	-	-	-	-	P	-
1933	<i>Zosterops palpebrosus</i>	-	P	-	-	-	P	-	-	-	-	P	-
1949	<i>Petronia xanthocollis*</i>	-	P	-	-	-	-	-	-	-	-	-	-
1973	<i>Lonchura kelaarti</i>	-	-	-	-	-	P	-	-	-	-	-	-
1978	<i>Lonchura malacca</i>	P	-	-	-	-	-	P	-	P	P	-	-

* = Recorded only from Mukkali, P = Present, (-) Not recorded; Serial numbers correspond to Handbook of Ali and Ripley (1983)

DISCUSSION

Vegetation: The higher rate of recruitment of new seedlings at Silent Valley was mainly due to the protection afforded to the National Park and adjacent forests, and its distance from

human settlements. Fire and tree felling appeared to have thinned this tract. One hundred and one dead trees were recorded on both sides of the transect, within a width of 10 m at Silent Valley, whereas only 10 such were recorded from Mukkali. However, at Mukkali, the forests being

TABLE 7
COMMONNESS AND DOMINANCE INDEX
OF SELECTED SPECIES AT MUKKALI
(MOIST DECIDUOUS FOREST)

No.	Species	Commonness Index	Dominance Index
1.	<i>Dicrurus macrocercus</i>	2.08	5.94
2.	<i>Megalaima viridis</i>	2.04	5.47
3.	<i>Turdoides striatus</i>	1.74	19.08
4.	<i>Pycnonotus cafer</i>	1.47	4.61
5.	<i>Dicrurus paradiseus</i>	1.17	3.17
6.	<i>Iole indicus</i>	0.89	3.13
7.	<i>Streptopelia chinensis</i>	0.85	2.20
8.	<i>Dinopium benghalense</i>	0.83	2.09
9.	<i>Copsychus saularis</i>	0.70	1.94
10.	<i>Psittacula cyanocephala</i>	0.68	3.42

Moist Deciduous, trees with a height of more than 30 m were less and due to selective felling in this area in earlier periods, trees of more than 270 cm GBH were few. As the quadrats assessed for percentage tree composition were on both sides of the transect line, it is quite natural that pioneer species like *Macaranga peltata* and *M. indica* were abundant in the area. This tract had a history of fire during early 1980s, i.e. before the area was declared a National Park. Maturity Index showed a lower value, which is usually obtained in the stages of succession. Diversity of tree species was high, which is correlated with the bird density.

At Mukkali, no major difference was seen in the occurrence of tree species in the forest areas and estate. Both areas had the same number of tree species.

Birds: Composition and diversity of trees have a great influence on the occurrence of birds. During this study, birds were observed 4,500

TABLE 8
MONTHLY VARIATION
IN THE BIRD SPECIES RICHNESS
AT SILENT VALLEY AND MUKKALI (MEAN)

Area	Months											
	J	F	M	A	M	J	J	A	S	O	N	D
Silent Valley	55	42	46	34	40	23	26	27	34	21	39	42
Mukkali	46	36	53	44	29	43	25	17	33	28	38	27

times, in which a total of 9,921 birds were counted. Of the 137 species identified from the two vegetation types, 21 migrant species were from Silent Valley and 11 were from Mukkali; others were residents. Fifty-six species were common to both the vegetation types, while 30 species were found only in the Evergreen and 21 only in the Moist Deciduous Forest. This indicates the importance of Evergreen forests in the conservation of birds. Most of the species showed only local movements. The migrants, which were recorded from Silent Valley, were the wagtails (*Motacilla* sp.), common rosefinch (*Carpodacus erythrinus*) and red-winged crested cuckoo (*Clamator coromandus*). Distinct changes in species composition were recorded among the birds of the Silent Valley and Mukkali over different months. During monsoon, the number of species present in the Silent Valley was low.

Most of the doves, pigeons, parakeets and black bulbuls (*Hypsipetes madagascariensis*) were not recorded in the monsoon at Silent Valley, but were seen returning to the area with the retreat of the rain. The yellow-browed bulbul is the most common and dominant species at Silent Valley. The second common species, the white-cheeked barbet comes only sixth in dominance. From the Dominance Index, it is clear that barring a few species, all are very rare. Due to the heavy mist and low activity of birds during monsoon, it was difficult to detect them, which may be one reason for the lower numbers recorded. Also, local movement of species like the black bulbul to the Evergreen Forest was observed during summer.

A major difference between the two bird communities lay in the composition of the bird species. The study suggests that the high diversity index of vegetation is an indication of increased bird density in tropical forests (Table 9). More unique and endemic species were recorded from the Evergreen Forest, which showed the influence of vegetation on species

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TABLE 9
COMPARISON OF BIRD COMMUNITY PARAMETERS WITH DIVERSITY INDICES OF VEGETATION

Areas	Vegetation indices		Bird community parameters			
	Maturity Index	Diversity Index H'	Species Richness	Density*	Diversity Index H'*	Endemic Species
Silent Valley	2.85	2.91	99	1,122/km ²	3.30	8
Mukkali	10.00	2.57	96	780/km ²	3.45	4

*Jayson and Mathew (2000a)

composition of birds. It seems that rare species like the great pied hornbill (*Buceros bicornis*) and the great black woodpecker (*Dryocopus javensis*) were affected severely during the pre-survey period of the abandoned hydroelectric project, because most of the dry trees were burnt for firewood and the great pied hornbill was hunted for its flesh (Vijayan and Balakrishnan 1977). Presence of endemic and globally threatened species showed the conservation value of Tropical Evergreen forests at Silent Valley.

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APPENDIX I

TOTAL NUMBER OF EXAMPLES SEEN IN EACH BIRD SPECIES AT SILENT VALLEY AND MUKKALI

Species	Abundance		Species	Abundance	
	Silent Valley	Mukkali		Silent Valley	Mukkali
<i>Hypsipetes indicus</i>	1070	87	<i>Hirundo domicola</i>	180	-
<i>Hypsipetes madagascariensis</i>	488	48	<i>Pycnonotus jocosus</i>	178	172
<i>Gracula religiosa</i>	423	25	<i>Psittacula krameri</i>	147	63
<i>Turdoides striatus</i>	240	530	<i>Dicrurus adsimilis</i>	128	165
<i>Saxicola caprata</i>	226	39	<i>Gallus sonneratii</i>	105	26
<i>Nectarinia minima</i>	222	4	<i>Lonchura malacca</i>	104	32
<i>Megalaima viridis</i>	221	152	<i>Myiophonus horsfieldii</i>	101	13

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APPENDIX I (CONTD.)

TOTAL NUMBER OF EXAMPLES SEEN IN EACH BIRD SPECIES AT SILENT VALLEY AND MUKKALI

Species	Abundance		Species	Abundance	
	Silent Valley	Mukkali		Silent Valley	Mukkali
<i>Zosterops palpebrosus</i>	101	50	<i>Copsychus saularis</i>	3	-
<i>Dendrocitta vagabunda</i>	86	26	<i>Chloropsis aurifrons</i>	3	55
<i>Dinopium benghalense</i>	80	58	<i>Haliastur indus</i>	2	-
<i>Carpodacus erythrinus</i>	79	-	<i>Columba livia</i>	2	-
<i>Perdicula erythrorhyncha</i>	75	-	<i>Cyornis pallipes</i>	2	-
<i>Pomatorhinus schisticeps</i>	69	2	<i>Nectarinia zeylonica</i>	2	41
<i>Pericrocotus flammeus</i>	58	73	<i>Zoonavena sylvatica</i>	2	-
<i>Parus xanthogenys</i>	55	20	<i>Ducula aenea</i>	2	7
<i>Psittacula cyanocephala</i>	52	95	<i>Lanius sp.</i>	2	5
<i>Treron phoenicoptera</i>	52	-	<i>Acridotheres tristis</i>	2	53
<i>Dicrurus paradiseus</i>	43	88	<i>Turdus merula</i>	2	12
<i>Treron pompadora</i>	41	11	<i>Ardeola grayii</i>	2	-
<i>Cyornis tickelliae</i>	41	-	<i>Falco sp.</i>	1	1
<i>Psittacula columboides</i>	35	13	<i>Dendrocitta vagabunda</i>	1	-
<i>Motacilla flava</i>	35	22	<i>Clamator coromandus</i>	1	-
<i>Zoothera citrina</i>	31	17	<i>Eumyias albicaudata</i>	1	-
<i>Chalcophaps indica</i>	27	-	<i>Dinopium javanense</i>	2	7
<i>Phylloscopus sp.</i>	27	11	<i>Pycnonotus melanicterus</i>	1	1
<i>Ocyceros griseus</i>	25	6	<i>Picumnus innominatus</i>	1	-
<i>Sitta frontalis</i>	23	4	<i>Rhopocichla atriceps</i>	1	-
<i>Ducula badia</i>	18	-	<i>Anthus hodgsoni</i>	2	-
<i>Dicrurus aeneus</i>	17	19	<i>Hirundo sp.</i>	-	66
<i>Pellorneum ruficeps</i>	16	-	<i>Centropus sinensis</i>	1	-
<i>Pycnonotus cafer</i>	16	128	<i>Dicrurus caerulescens</i>	1	-
<i>Elanus caeruleus</i>	14	5	<i>Picumnus innominatus</i>	1	-
<i>Loriculus vernalis</i>	13	13	<i>Corvus macrorhynchos</i>	1	6
<i>Arachnothera longirostra</i>	13	1	<i>Aegithina tiphia</i>	1	6
<i>Lonchura punctulata</i>	13	-	<i>Irena puella</i>	1	3
<i>Dicaeum erythrorhynchos</i>	13	-	<i>Muscicapa latirostris</i>	1	-
<i>Dryocopus javensis</i>	12	-	<i>Asio flammeus</i>	1	1
<i>Ictinaetus malayensis</i>	11	2	<i>Harpactes fasciatus</i>	1	2
<i>Hirundo daurica</i>	11	1	<i>Muscicapa muttui</i>	1	2
<i>Buceros bicornis</i>	11	1	<i>Streptopelia chinensis</i>	-	61
<i>Streptopelia chinensis</i>	9	-	<i>Eudynamys scolopacea</i>	-	3
<i>Nectarinia lotenia</i>	8	9	<i>Halcyon smyrnensis</i>	-	7
<i>Lonchura malabarica</i>	8	-	<i>Upupa epops</i>	-	2
<i>Terpsiphone paradisi</i>	8	3	<i>Picus chlorolophus</i>	-	10
<i>Hemicircus canente</i>	7	6	<i>Lanius vittatus</i>	-	9
<i>Turdoides affinis</i>	7	42	<i>Dicrurus hottentottus</i>	-	1
<i>Columba elphinstonii</i>	7	-	<i>Acridotheres fuscus</i>	-	7
<i>Spilornis cheela</i>	6	5	<i>Corvus splendens</i>	-	47
<i>Oriolus oriolus</i>	6	1	<i>Chloropsis cochinchinensis</i>	-	12
<i>Turdoides subrufus</i>	4	14	<i>Ficedula nigrorufa</i>	-	1
<i>Motacilla cinerea</i>	4	-	<i>Eumyias thalassina</i>	-	1
<i>Dicaeum agile</i>	4	-	<i>Dendronanthus indica</i>	-	5
<i>Oriolus chinensis</i>	4	-	<i>Orthotomus sutorius</i>	-	5
<i>Galloperdix spadicea</i>	4	-	<i>Monticola solitarius</i>	-	18
<i>Parus major</i>	3	13	<i>Petronia xanthocollis</i>	-	1
<i>Merops leschenaulti</i>	3	9			
<i>Accipiter badius</i>	3	1			

- = Not recorded